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# U.S. PATENT APPLICATION

## Dual Microphone Assembly for Mask

## Technical Field

[0001] The present invention relates to a microphone assembly for a mask. In particular, the present invention relates to microphone usable in connection with a mask of the type worn by someone wearing a protective mask or respirator.

## Background of the Invention

[0002] Masks of various types are worn by people for different reasons. For example, some occupations require the wearing of a mask at least part of the time. A firefighter may wear a mask to enable breathing of fresh air or gases such as oxygen. A mask may be, or include, an air purifying respirator or an air supplied respirator.

[0003] When a mask is worn, the user's mouth and nose may be covered. This can make it harder for the user to communicate orally with others nearby. Therefore, some masks include a communication system, such as a voice amplification system or a radio interface system. Some of these systems use microphones and amplifiers to help the user to be heard clearly outside the user's mask, either directly at the location or remotely vi a radio frequency connection.

## Summary of the Invention

[0004] The present invention relates to a microphone assembly for a mask. In particular, the present invention relates to a microphone assembly including two microphones, usable in connection with a mask of the type worn by someone wearing a protective mask

or respirator. The two microphones may share a common pass-through. The output signals of the two microphones may share one or more conductors in the pass-through. One microphone may support the other on the mask, or the microphones may be physically separate, or the microphones may be formed as one unit. The invention also relates to a mask having at least two microphones.

## Brief Description of the Drawings

[0005] The foregoing and other features of the present invention will become apparent to one skilled in the art to which the present invention relates upon consideration of the following description of the invention with reference to the accompanying drawings, in which:

[0006] Fig. 1 is a schematic front (outside) elevational view of a mask;

[0007] Fig. 2 is a schematic back (inside) elevational view of the mask of Fig. 1 including a microphone assembly in accordance with a first embodiment of the present invention;

[0008] Fig. 3 is an enlarged view of the microphone assembly of Fig. 1 shown supported on the inside of the mask;

[0009] Fig. 4 is an electrical schematic diagram of the microphone assembly of Fig. 1;

[0010] Fig. 5 is a back elevational view of the microphone assembly of Fig. 1, showing the two microphones separated from each other;

[0011] Fig. 6 is a side elevational view of the microphone assembly of Fig. 1, showing the two microphones separated from each other;

[0012] Fig. 7 is a front elevational view of the microphone assembly of Fig. 1, showing the two microphones separated from each other;

[0013] Fig. 8 is a back elevational view of the microphone assembly of Fig. 1, showing the two microphones assembled to each other;

[0014] Fig. 9 is a side elevational view of the microphone assembly of Fig. 1, showing the two microphones assembled to each other;

[0015] Fig. 10 is a front elevational view of the microphone assembly of Fig. 1, showing the two microphones assembled to each other; and

[0016] Fig. 11 is a view similar to Fig. 3 showing a microphone assembly in accordance with a second embodiment of the present invention.

## Detailed Description of the Invention

[0017] The present invention relates to a microphone assembly for a mask. In particular, the present invention relates to a microphone assembly including two microphones, usable in connection with a mask such as is worn by a firefighter or soldier for protection and breathing. The present invention is applicable to and may be embodied in various different microphone and mask constructions. As representative of the invention, Figs. 2-11 illustrate a microphone assembly 10 in accordance with a first embodiment of the invention. The microphone assembly 10 is shown in use with a mask 12 (Figs. 1-3).

[0018] The mask 12 includes a body 20. The mask body 20 is typically molded from a rubber-type material. As a result, the mask body 20 is flexible to fit over and adapt to the configuration of the user's face. The mask 12 includes a viewing window 22 set in the mask body 20. The viewing window 22 is located in front of the user's eyes when the mask 12 is in place.

[0019] It should be understood that the term "mask" or "face mask" or the like, as used herein, is intended to include (at least, and not limited to) any device that covers a wearer's mouth, for example, a helmet, a full face mask, a partial face mask, etc.

[0020] The mask 12 includes an air supply portal 24. The air supply portal 24 provides an air supply passage between the interior of the mask 12 and the exterior of the mask. The air supply portal 24 has an external connector 26 that is adapted to receive an air supply connection (not shown), such as an oxygen tube or similar device or filtered air.

[0021] The mask 12 includes a communications pass-through 30. The pass-through 30 is a portion of the mask 12 that provides a multi-conductor electrical connection between the interior of the mask and the exterior of the mask. In the illustrated embodiment, the pass-through 30 is located adjacent the air supply portal 24 and thus adjacent a user's mouth. The pass-through 30 could be located elsewhere on a mask, in other embodiments of the invention.

[0022] The pass-through 30 has an inner end portion 32 and an outer end portion 34. The inner end portion 32 has three pin openings 32a, 32b and 32c that are arranged in a particular pattern. The outer end portion 34 also has three pin openings 34a, 34b, and 34c that are arranged in the same pattern. The pass-through 30 has three conductors (not shown) extending between the inner end portion 32 and the outer end portion 34. The three conductors provide electrical connection between the internal pin openings 32a-32c and the external pin openings 34a-34c of the pass-through 30. Other pass-throughs could have more than three conductors or fewer than three conductors.

[0023] The pass-through 30 is used for directing the output signal of one or more microphones, located on the interior of the mask 12, to a location external of the mask. A radio unit (not shown), intercom, telephone, a voice projection unit, or any other communication device that needs a microphone signal to bring the user's voice outside the mask., can be connected to the outer end portion 34 of the pass-through 30.

[0024] The microphone assembly 10 includes a first microphone 40 and a second microphone 60. The first microphone 40, in the illustrated embodiment, is a powered, or

electret, microphone that is for use with a voice projection unit. The first microphone 40 has a body portion 42 that encloses a transducer shown schematically at 44 (Fig. 6).

[0025] The first microphone 40 also includes an electrical connector 46. The connector 46 has three projecting output pins 46a, 46b, and 46c that are arranged in a pattern that is identical to the pattern of the pin openings 32a-32c in the inner end portion 32 of the pass-through 30. Two conductors shown schematically at 48 extend between and electrically interconnect the transducer 44 and two of the three output pins, a first pin 46a and a common pin 46b.

[0026] The first microphone 40 also has a support portion 50. The support portion 50 of the first microphone 40 is adapted to support the second microphone 60, as described below. The support portion 50 in the illustrated embodiment includes two projecting metal pins 50a and 50b. The pins 50a and 50b of the support portion 50 are electrically connected inside the first microphone 40, in a manner not shown, with the second pin 46c and the common pin 46b of the connector 46.

[0027] The second microphone 60, in the illustrated embodiment, is for use with the radio unit and is a non-powered, or dynamic, microphone. The second microphone 60 has a body portion 62 that encloses a transducer shown schematically at 64.

[0028] The second microphone 60 also includes an electrical connector 66. The connector includes two metal sleeves 66a and 66b that are arranged in a pattern identical to the pattern of the two projecting pins 50a and 50b on the support portion 50 of the first microphone 40. The connector 66 on the second microphone 60 includes two set screws 68 (Fig. 3) that are movable transversely into the openings of the sleeves 66a and 66b. Two conductors shown schematically at 70 extend between and electrically interconnect the transducer 64 and the sleeves 66a and 66-b.

[0029] The second microphone 60 is electrically and mechanically connectable with the first microphone 40 to form a single, modular unit 10 that is usable with the single, three-

conductor pass-through 30. To connect the two microphones, the two pins 50a and 50b of the first microphone 40 are received in the two sleeves 66a and 66b, respectively, of the second microphone 60. The engagement of the pins 50a and 50b in the sleeves 66a and 66b establishes an electrical connection between the second microphone 60 and the first microphone 40.

[0030] As a result, there is an electrical connection between the transducer 64 of the second microphone 60 and the second pin 46c and the common pin 46b, through the first microphone 50. Thus, the output signal of the second microphone 60 is present at the output pins 46b and 46c. At the same time, the output signal of the first microphone is present at the output pins 46a and 46b.

[0031] The set screws 68 of the connector 66 of the second microphone 60 can be tightened down on the pins 50a and 50b, to help secure the second microphone mechanically to the first microphone 40.

[0032] The assembly 10 of the first microphone 40 and the second microphone 60 is supported as one unit on the mask 12. Specifically, the assembly 10 of the first microphone 40 and the second microphone 60 is supported on the inner end portion 32 of the pass-through 30. The three output pins 46a-46c of the first microphone 40 engage in the three pin openings 32a-32c, respectively, of the inner end portion 32 of the pass-through 30. As a result, the output signal of the first microphone 40 is electrically connected with the pass-through 30. The first microphone 40 is also mechanically supported on the pass-through 30.

[0033] Because the second microphone 60 is mechanically supported on the first microphone 40, the second microphone is also mechanically supported on the pass-through 30. Because the second microphone 60 is electrically connected with the three output pins 46a-c of the first microphone 40, the output signal of the second microphone also is electrically connected with the pass-through 30. Thus, a separate electrical connection for the second microphone 60 is not needed, as it is piggy backed on the

electrical connection for the first microphone 40. Both the first microphone 40 and the second microphone 60 are active at all times.

[0034] Because the microphone assembly 10 is a modular unit, different microphone combinations are possible. For example, the invention could be embodied in a microphone assembly 10 that includes a dynamic microphone that supports a powered microphone. The invention could be embodied in a microphone assembly 10 that includes two of the same kind of microphone--for example, a powered microphone that supports another powered microphone, or a non-powered microphone that supports another non-powered microphone. One of the microphones could be a bone-conducting microphone, which uses an accelerometer to convert bone vibration resulting form voice, into an electric signal. The invention could also be embodied in a microphone assembly 10 that includes more than two microphones.

[0035] In addition, the invention could also be embodied in a microphone assembly that includes a single electrical connector that plugs into the mask 12, and from which two microphones are supported electrically and mechanically. Such a microphone assembly 100 is shown in Fig. 11. The microphone assembly 100 includes a first microphone 102 and a second microphone 104. The microphone assembly 100 also includes a base 106. The base 106 supports the first and second microphones 102 and 104 mechanically on the pass-through 30 (not shown in Fig. 11) of the mask 12. The base 106 also serves as an electrical connector that electrically connects both the first microphone 102 and the second microphone 104 with the pass-through 30.

[0036] In addition, the invention could be embodied in a microphone assembly that includes two individual microphones that are permanently assembled to each other. Alternatively, the invention could be embodied in a microphone assembly that is formed as one unit with two individual transducers in it (as opposed to being two individual microphones that are permanently assembled to each other). This is illustrated in Fig. 12 which shows a microphone assembly 110 mounted on a mask 112. The microphone

assembly 110 includes a first microphone 114 and a second microphone 116. The two microphones 114 and 116 are mounted or installed in a single package or housing 118.

[0037] Fig. 13 illustrates a further embodiment of the invention in which the two microphones are not physically joined but are instead mounted at spaced apart locations on the mask. A first microphone 120 is mounted on the mask 122 at a location spaced apart from a pass-through 124. A second microphone 126 is mounted on the pass-through 124. The second microphone 126 could, alternatively, be mounted off the pass-through 124, like the first microphone 120.

[0038] The first microphone 120 and the second microphone 126 are connected by wiring indicated schematically at 128. Thus, the two microphones 120 and 126 share a common pass-through 124. As noted above, the pass-through 124 could be located elsewhere on the mask 122 than as shown.

[0039] From the above description of the invention, those skilled in the art will perceive improvements, changes, and modifications in the invention. Such improvements, changes, and modifications within the skill of the art are intended to be included within the scope of the appended claims.